# CLAIMS

What is claimed is:

1. A method for producing an optical grating comprising:

designing an optical pattern;

inducing a sufficient number of errors into the pattern to reduce the average of the errors to a predetermined number; and

recording the pattern with the sufficient number of errors into an optical element.

2. The method of claim 1 wherein the pattern comprises a plurality of segments, and the step of inducing errors comprises:

writing an additional number of segments than are required by a desired design.

3. The method of claim 1 wherein:

the predetermined number is about zero.

4. The method of claim 1 wherein:

the optical element is a mask, and the mask is used to form the grating.

5. The method of claim 4 wherein the step of recording comprises the step of:

exposing the mask with at least one beam.

6. The method of claim 4 wherein:

the errors are stitching errors; and

a group delay ripple error of the grating is decreased as the number of stitching errors is increased.

7. The method of claim 1 wherein:

the pattern includes information associated with one of a linear chirp and a non-linear chirp.

8. The method of claim 1 wherein the pattern comprises a plurality of segments, and the step of inducing comprises:

inducing a plurality of stitching errors into the pattern.

9. The method of claim 8 wherein the step of inducing the sufficient number of errors further comprises:

forming at least one segment to have a different period by adjusting a scaling factor of manufacturing equipment that is used in the step of recording.

10. The method of claim 8 wherein:

each segment has an arbitrary period with respect to at least one of a previous segment and a subsequent segment in the pattern.

11. The method of claim 8 wherein the pattern comprises a plurality of bars and spaces, and the step of inducing the plurality of stitching errors comprises:

adjusting desired locations of edges of bars and spaces to pixel locations that are useable by manufacturing equipment used in the step of recording.

12. The method of claim 11 wherein:

the pixel locations coincide with a periodic grid.

13. The method of claim 12 wherein:

a size of the period of the grid is 25 nm or less.

14. The method of claim 12 wherein:

a size of the period of the grid is 10 nm or less.

15. The method of claim 11 wherein the step of adjusting comprises:

adjusting each of the desired locations to the nearest pixel location.

16. The method of claim 11 wherein:

the step of adjusting moves each desired location by up to one half of pixel spacing.

17. The method of claim 8 wherein the step of inducing a plurality of stitching errors comprises:

forming a plurality of sub-segments for each segment of the plurality of segments.

18. The method of claim 17 wherein:

at least one segment has a different period; and

each sub-segment has the same period as the segment from which it was formed.

19. The method of claim 17 wherein:

at least one segment has a different period; and

each sub-segment has a scaled period, such that sequential sub-segments from a particular segment have periods that range from a period that is greater than the period of a previous segment to a period that is less than the period of a subsequent segment.

20. The method of claim 17 wherein:

each sub-segment has an arbitrary period with respect to at least one of a previous sub-segment and a subsequent sub-segment.

21. The method of claim 1 wherein the pattern is continuously recorded into the optical element and comprises a plurality of bars and spaces, and the step of inducing comprises:

adjusting desired locations of edges of bars and spaces to pixel locations that are useable by manufacturing equipment used in the step of recording.

22. The method of claim 21 wherein:
the pixel locations coincide with a periodic grid.

23. The method of claim 22 wherein:
a size of the period of the grid is 25 nm or less.

24. The method of claim 22 wherein:
a size of the period of the grid is 10 nm or less.

25. The method of claim 21 wherein the step of adjusting comprises:
adjusting each of the desired locations to the nearest pixel location.

26. The method of claim 21 wherein:
the step of adjusting moves each desired location by up to one half of pixel spacing.

27. The method of claim 1 wherein the step of recording comprises the step of:
writing the pattern with at least one raster scanned e-beam.

28. The method of claim 1 wherein the step of recording comprises the step of:
writing the pattern with at least one raster scanned laser beam.

29. The method of claim 28 wherein:
the step of writing uses at least 24 beams.

30. The method of claim 28 wherein the step of writing uses a plurality of beams in parallel, and the method further comprises:
repeating the step of writing for multiple exposures and thereby reduce placement error.

31. The method of claim 1 wherein the step of recording comprises the step of:
writing the pattern with at least one shaped e-beam.

32. The method of claim 31 wherein the step of writing the pattern with at least one shaped e-beam comprises the step of:
writing a plurality of at least one type of geometrical shape.

33. The method of claim 32 wherein the step of writing the pattern further comprises the step of:
performing the step of writing the plurality of at least one type of geometrical shape for a sub-field of the optical element;
repositioning writing equipment after the step of performing for a subsequent sub-field.

34. The method of claim 1 wherein the step of recording operates with manufacturing equipment with a writing grid size of less than or equal to 10 nanometers.

35. The method of claim 1 wherein the step of recording operates with manufacturing equipment with a writing grid size of less than or equal to 25 nanometers.

36. The method of claim 1 wherein:

optical element is a fiber, and the step of recording forms the grating in the fiber.

37. The method of claim 36 wherein:

a group delay ripple error of the grating is decreased as the number of errors is increased.

38. The method of claim 1 further comprising:

including at least one phase shift in the pattern;

wherein the step of recording is operative to record the pattern with the at least one phase shift into the optical element.

39. An optical mask that is useable to produce a grating comprising:

a pattern of bars and spaces, wherein the pattern includes a sufficient number of errors in the pattern to reduce the average of the errors to a predetermined number.

40. The mask of claim 39 wherein:

edges of the bars and spaces are locations coinciding with a periodic grid.

41. The mask of claim 40 wherein:

a size of the period of the grid is 25 nm or less.

42. The mask of claim 40 wherein:

a size of the period of the grid is 10 nm or less.

43. The mask of claim 39 wherein the pattern comprises a plurality of segments, and a number of the plurality of segments is greater than a number of segments required by a desired design.

44. The mask of claim 39 wherein:

the predetermined number is about zero.

45. The mask of claim 39 wherein:

the pattern includes information associated with one of a linear chirp and a non-linear chirp.

46. The mask of claim 39 wherein:

the errors are stitching errors; and

a group delay ripple error of the grating is decreased as the number of stitching errors is increased.

47. The mask of claim 39 wherein:

the pattern comprises a plurality of segments.

48. The mask of claim 47 wherein

at least one segment has a period that is different by a scaling factor.

49. The mask of claim 47 wherein:

each segment has an arbitrary period.

50. The mask of claim 47 wherein:

the errors are stitching errors induced by adjusting edges of the bars and spaces from desired locations of the edges of bars and spaces.

51. The mask of claim 50 wherein:

the edges of the bars and spaces are locations coinciding with a periodic grid.

52. The mask of claim 51 wherein:
a size of the period of the grid is 25 nm or less.

53. The mask of claim 51 wherein:
a size of the period of the grid is 10 nm or less.

54. The mask of claim 47 wherein:
each segment comprises a plurality of sub-segments.

55. The mask of claim 54 wherein:
at least one segment has a different period; and
each sub-segment has the same period as its associated segment.

56. The mask of claim 39 wherein:
the errors are induced by adjusting edges of the bars and spaces from desired locations of the edges of bars and spaces.

57. The mask of claim 39 wherein:
the pattern includes at least one phase shift.

58. A system that produces an optical grating, the system comprising:

means for designing an optical pattern;

means for inducing a sufficient number of errors into the pattern to reduce the average of the errors to a predetermined number; and

means for recording the pattern with the sufficient number of errors into an optical element.

59. The system of claim 58 wherein the pattern comprises a plurality of segments, and the means for inducing errors comprises:

means for writing additional segments than are required by a desired design.

60. The system of claim 58 wherein:

the predetermined number is about zero.

61. The system of claim 58 wherein:

the optical element is a mask, and the mask is used to form the grating.

62. The system of claim 61 wherein the means for recording comprises:

means for exposing the mask with at least one beam.

63. The system of claim 61 wherein:

the errors are stitching errors, and

a group delay ripple error of the grating is decreased as the number of stitching errors is increased.

64. The system of claim 58 wherein:

the pattern includes information associated with one of a linear chirp and a non-linear chirp.

65. The system of claim 58 wherein the pattern comprises a plurality of segments, and the means for inducing comprises:

means for inducing a plurality of stitching errors into the pattern.

66. The system of claim 65 wherein the means for inducing the sufficient number of errors further comprises:

means for forming at least one segment to have different a period by adjusting a scaling factor of the means for recording.

67. The system of claim 65 wherein:

each segment has an arbitrary period with respect to at least one of a previous segment and a subsequent segment in the pattern.

68. The system of claim 65 wherein the pattern comprises a plurality of bars and spaces, and the means for inducing the plurality of stitching errors comprises:

means for adjusting desired locations of edges of bars and a spaces to pixel locations that are useable by the means for recording.

69. The system of claim 68 wherein:

the pixel locations coincide with a periodic grid.

70. The system of claim 69 wherein:
a size of the period of the grid is 25 nm or less.

71. The system of claim 69 wherein:
a size of the period of the grid is 10 nm or less.

72. The system of claim 68 wherein the means for adjusting comprises:

means for adjusting each of the desired locations to the nearest pixel location.

73. The system of claim 68 wherein:

the means for adjusting moves each desired location by up to one half of pixel spacing.

74. The system of claim 65 wherein the means for inducing a plurality of stitching errors comprises:

means for forming a plurality of sub-segments for each segment of the plurality of segments.

75. The system of claim 74 wherein:

at least one segment has a different period; and

each sub-segment has the same period as the segment from which it was formed.

76. The system of claim 74 wherein:

at least one segment has a different period; and

each sub-segment has a scaled period, such that sequential sub-segments from a particular segment have periods that range from a period that is greater than the period of a previous segment to a period that is less than the period of a subsequent segment.

77. The system of claim 74 wherein:

each sub-segment has an arbitrary period with respect to at least one of a previous sub-segment and a subsequent sub-segment.

78. The system of claim 58 wherein the pattern is continuously recorded into the optical element and comprises a plurality of bars and spaces, and the means of inducing comprises:

means for adjusting desired locations of edges of bars and spaces to pixel locations that are useable by the means for recording.

79. The system of claim 78 wherein:

the pixel locations coincide with a periodic grid.

80. The system of claim 79 wherein:

a size of the period of the grid is 25 nm or less.

81. The system of claim 79 wherein:

a size of the period of the grid is 10 nm or less.

82. The system of claim 78 wherein the means for adjusting comprises:

means for adjusting each of the desired locations to the nearest pixel location.

83. The system of claim 78 wherein:

the means for adjusting moves each desired location by up to one half of pixel spacing.

84. The system of claim 58 wherein the means for recording comprises:

means for generating at least one raster scanned e-beam.

85. The system of claim 58 wherein the means for recording comprises:

means for generating at least one raster scanned laser beam.

86. The system of claim 85 wherein:

the means for generating at least one raster scanned laser beam generates at least 24 beams.

87. The system of claim 85 wherein:

the means for generating at least one raster scanned laser beam generates a plurality of beams in parallel and are used for multiple exposures and thereby reduce placement error.

88. The system of claim 58 wherein the means for recording comprises:

means for generating at least one shaped e-beam.

89. The system of claim 88 wherein the at least one shaped e-beam writes a plurality of at least one type of geometrical shape.

90. The system of claim 89 wherein the means for generating at least one shaped e-beam writes the plurality of at least one type of geometrical shape for a sub-field of the optical element, and repositions after writing for a subsequent sub-field.

91. The system of claim 58 wherein the means for recording has a writing grid size of less than or equal to 10 nanometers.

92. The system of claim 58 wherein the means for recording has a writing grid size of less than or equal to 25 nanometers.

93. The system of claim 58 wherein:

the optical element is a fiber, and means for recording forms the grating in the fiber.

94. The system of claim 93 wherein:

a group delay ripple error of the grating is decreased as the number of errors is increased.

95. The system of claim 58 wherein:

the pattern includes at least one phase shift; and

the means for recording is operative to record the pattern with the at least one phase shift into the optical element.